Indicators for Success: Fostering an Environment for Technology Transfer and Innovation in the DoD Laboratory Enterprise

The Department of Defense (DoD) Research and Development (R&D) laboratories have long served as beacons of innovation and invention. From the Manhattan Project to ARPA Net (precursor to the internet), DoD R&D labs have strived to attract the best and brightest to staff their laboratories, eager for new, cutting edge technologies to support U.S. military superiority. But the world is changing. The best and brightest are moving on to new hubs of innovation and entrepreneurship like Silicon Valley and globalization has further intensified competitive pressure in the race to innovate. In this rapidly changing landscape, the DoD R&D lab enterprise must not only work harder to develop new technology, but also work smarter to commercialize and transfer these technologies if the U.S. is to remain a leader in innovation and maintain technological superiority for both the battlefield and the commercial sector.

Technology transfer (T2) describes a wide range of organizational processes and interactions which together serve to transmit basic research from a basic research lab to another organizational partner who subsequently provides development towards producing a commercially viable product or technology to generate revenues and royalties. The T2 process can promote innovation, particularly for federally funded labs, by moving technologies into the public domain and encouraging overall knowledge diffusion[1]. This prospect can be especially attractive to organizations like the DoD, as basic research is turned into viable products to be integrated into larger systems, at far lower cost than if DoD were to provide end-to-end R&D for the technology. Federal T2 success stories include technologies like global positioning systems (GPS) and semiconductors.

The proposed study will examine the correlates and possible indicators for successful technologies and inventions at DoD R&D laboratories by mining and analyzing the administrative records of a DoD R&D lab in the Northeast (hereafter, "DoD Lab") as a pilot. The notional model of successful T2 will enable process improvement at DoD Lab to improve the efficiency and effectiveness of the commercialization of DoD Lab's intellectual property (IP) and technology.

Research Questions

This study will answer the follow research questions:

- What constitutes a successful technology transfer?
- How are basic science and programmatic inputs correlated with successful technologies?
- How can the technology transfer process be improved to allow for more efficient transfer from federal labs to the public, while documenting the public value of such transfers?

The motivating hypotheses for the proposed study are that successful T2 at DoD R&D labs will come from recent IP or patents in well-funded research directorates and that successful T2 will involve well-connected researchers with robust social networks, as measured though publishing and patenting activity.

Data and Methods

The primary data source for this study will be digitized administrative records from the DoD Lab's T2 office. These documents have already been digitized by the proposer and are ready to be analyzed. Documents include (but are not limited to): patent license agreements; cooperative research and development agreements (CRADAs); joint ownership agreements; patent assignments; and test service agreements. DoD Lab administrative records will be mined for data on royalty distributions, characteristics of transferred technologies, correlates of successful agreements, and creation of value, both monetary and in-kind contributions, arising from federal R&D lab-developed technology. These data will be complemented with regional economic development and demographic data to provide a fuller picture of the overall ecosystem in which the lab operates. The patents corresponding with the administrative records will also be mined for data pertaining to the technology and the inventor.

The main sources of this secondary data will be the American Community Survey and the Current Population Survey. Both of these sources will provide information about the income and business activities in the county around the DoD Lab. Key variables will include:

- Royalty distributions

[1] Bozeman, Barry. "Technology transfer and public policy: a review of research and theory." Research policy 29, no. 4 (2000): 627-655.

- IP/patent characteristics (date granted/disclosed, Lab research directorate, forward citations)
- Agreement characteristics (exclusivity, length, mechanism type)
- Licensee/partner characteristics (business type, location, history with Lab)
- Inventor characteristics (publishing activity, patenting activity, co-authors, co-inventors)
- Businesses in the county and their revenue trends

In order to address the research questions presented above, logistic regressions will model "successful transfer" as the dependent variable. The independent variables will include characteristics of the patents, the T2 agreement, and the inventor, as described above, as well as metrics derived from a social network analysis of the inventors' networks. Bayesian Markov Chain Monte Carlo (MCMC) methods will also be deployed, which will allow for more robust and accurate predictions that better match the logics and assumptions acceptable to federal R&D audiences by accounting for the prior distribution and reporting credibility intervals, which are more intuitive in their interpretation. The analysis of the inventors' social network will aid in assessing the extent of innovation and knowledge diffusion as well as the innovation culture at the DoD Lab. To complete this analysis, the inventors' publishing and patenting relationships will be mapped, including a citation analysis, and assessed for robustness. Exact model specification will rely on data availability and quality. These models will form the basis for a tool by which new innovations and IP can be assessed by the DoD Lab administrators – and, potentially those at other Federal labs -- to determine potential viability in commercial markets and expected returns on federal R&D investments, permitting more efficient and effective T2.

Data Management Plan

In order to ensure privacy and confidentiality, the study will involve multi-level de-identification of the data set at the researcher, lab, and DoD component levels. This will be accomplished through assignment of case ID numbers by the lead researcher for the study. Institutional Review Board oversight will also be sought for this project.

Katie Seely-Gant

Analyst

Skills

- SPSS, STATA, Excel, VBA, and R
- Econometric models
- Evaluation and assessment

Education

- Masters of Public Policy, George Washington University (2014)
- BA in History/ Classical Languages, Duquesne University (2013)

Selected Publications

- **Seely-Gant, K**. (2015) "Road to 2015: Pre-college Gender Parity and UNESCO's Millennium Development Goals" in *Advancing Women in Science: An International Perspective* pp.27-32, eds. Pearson Jr., W., L. M. Frehill & C. L. McNeely. Springer.
- **Seely-Gant, K.** and L. M. Frehill, (2015) "Selection Bias in Big Data Research", *Journal of the Washington Academy of Science*. Vol 101, no. 3

Selected Presentations

- **Seely-Gant, K.** (2016) "A World Away: Doing Science Abroad", workshop panelist at the American Association for the Advancement of Science's 2016 Annual Meeting
- **Seely-Gant, K., Organizer,** "Improving Pathways, Access, and Opportunities: Science Literacy for the Human Good", panel presented at the 2015 DuPont Summit, Washington, D.C.
- Ghertner, R., **K. Seely-Gant**, and J. Breems. (2015) "Evaluating the Alignment of Grant Allocation and Community Need Using Bayesian Spatial Probit Models: A Case Study of AmeriCorps", presented at the Federal Committee on Statistical Methodology Conference

Summary

A research professional, concentrating in program evaluation and data analysis, Ms. Seely-Gant provides research and analytics support on a wide variety of projects in areas including STEM workforce and career pathways, diversity and inclusion in technical workforces, international science collaboration, program evaluation and assessment, research design, and social science methodologies.

Relevant Experience

Analyst, Energetics Technology Center (5/15 — present)

- Supervise interns in supporting the ETC Analytics Group
- Project management
  - E-learning for technology transfer (T2) and entrepreneurship
  - Performance measurement and metrics for federal T2
- Research, Analytics, and Evaluation support
  - Research posters, conference presentations, and journal articles
  - Primary and secondary data collection and analyses
  - Data cleaning and management

Research Intern, Energetics Technology Center (5/12-5/15)

- Research Assistant for Evaluation of the Mentoring Women in International Research Collaborations Program, administered by the American Association for the Advancement of Science:
  - Designed and administered survey
  - Collected and analyzed survey results and program outcomes
  - Co-authored final report and website materials
- Researched and wrote supporting materials, including analysis, for STEM Workforce Report for the Office of the Assistant Secretary of the Navy

Intern, Corporation for National and Community Service (9/14- 5/15)

- As a member of the research team in the Office of Research and Evaluation:
  - Reviewed research and literature, survey and research design
  - Prepare justification packets for OMB clearance
  - Analyzed data in STATA, SPSS, and R including structural equation modeling, and linear and logistic regression modeling, and spatial models using both Bayesian and frequentist methods
  - Drafted survey instruments, evaluation plans, and logic models
  - Served as review panelist in 2015 Research Grant Competition

Masters Capstone Project, George Washington University (8/14- 12/14)

- As a member of the GW research team, completed an assessment of the Energy Devices and High Performance Buildings Tax Credit Programs in Howard County, MD:
  - Collected, cleaned, and prepared data for analysis using STATA
  - Conducted analyses on effect and impact of Tax Credit Programs (STATA)
  - Analyzed difference-in-differences regression and propensity score match models to assess overall impact of programs